Endovascular native vessel recanalization to maintain limb perfusion after infected prosthetic vascular graft excision

Victor Z. Erzurum, MD, and **Dan Clair, MD,** *Cleveland, Ohio*

Prosthetic vascular graft infection is an uncommon yet serious condition. Traditional management has included debridement, excision of the infected graft, and revascularization as needed. We report on two cases in which limb viability was maintained by using endovascular native vessel recanalization after excision of infected prosthetic grafts. This approach was successful in maintaining adequate limb perfusion in both cases. Endovascular native vessel recanalization should be considered as an option to maintain limb viability after excision of infected prosthetic vascular grafts, especially when autogenous conduit is lacking or limitation of the extent of surgery is desirable. (J Vasc Surg 2005;41:332-6.)

Infection of prosthetic vascular grafts has been reported to occur in only 1% to 3% of all arterial reconstructions.[1-3] Nevertheless, when graft infection does occur, the consequences can be unfortunate and associated with a significant rate of limb loss and mortality. Both graft location and infecting pathogen influence these adverse event rates. In the worst situation limb loss rates can be as high as 70%, and mortality rates from 10% to 15%[1,3,4] have been reported.

Management of infected grafts typically consists of debridement of infected tissues, removal of infected prosthetic grafts, and, when necessary, revascularization. Often the overall management of these patients requires a creative mentality, and the variety of therapeutic options should be individualized for each. No single approach is likely to be ideal in all situations.

Here we describe an approach for revascularization after excision of infected grafts involving endovascular recanalization of native vessels. Endovascular recanalization might be desirable in patients with limited physiologic tolerance for major open revascularization or with limited autogenous conduit.

CASE 1.

A 48-year-old diabetic smoker presented to an outside hospital with gangrene of the right 5th toe. She subsequently underwent common femoral to above knee popliteal bypass with a polyethylene terephthalate (Dacron) graft. Her postoperative course was complicated by myocardial infarction, respiratory failure, and acute renal failure. In addition, by postoperative day 8 she had purulent drainage from both her groin and knee incisions culture positive for *Escherichia coli*.

Fig 1. After amputation of 5th toe and excision of femoral popliteal graft, the patient in case 1 had progressive ischemia of her foot.

The patient was transferred to our institution on postoperative day 11 and at that time remained critically ill, with respiratory failure and renal failure mandating dialysis. In addition, she had signs of sepsis from a prosthetic graft infection.

After appropriate antibiotic therapy with Zosyn (piperacillin/tazobactam; Wyeth, Madison, NJ), the patient was medically optimized and underwent graft excision with vein patching of the common femoral and popliteal arteries. Gross purulence of the graft and was identified, and intraoperative cultures also grew *E coli*. Open amputation of her gangrenous toe was also performed. No attempt at operative revascularization was made because of her poor clinical condition and limited autogenous conduit.

From the Department of Vascular Surgery, Cleveland Clinic Foundation, Cleveland, Ohio.
Competition of interest: none.
Reprint requests: Victor Z. Erzurum, MD, Department of Vascular Surgery/S40, Cleveland Clinic Foundation, Cleveland, OH 44195. (e-mail: vzerzurum@yahoo.com).
0741-5214/$30.00

doi:10.1016/j.jvs.2004.10.041

Fig 2. Angiogram before superficial femoral artery (SFA) recanalization in case 2. *Arrows* designate SFA occlusion and popliteal reconstitution.

Fig 3. Completion angiogram after successful subintimal angioplasty of SFA occlusion in case 1.

The patient's limb remained marginally viable with progression of ischemia at the amputation margins (Fig 1). Eight days after excision of her graft a decision was made to attempt endovascular recanalization of her native vessels.

Initial angiogram showed superficial femoral artery occlusion with popliteal reconstitution and two-vessel runoff (Fig 2). After placing a long sheath up and over the aortic bifurcation from a contralateral retrograde approach, the superficial femoral artery was recanalized by passing a stiff guidewire (Boston Scientific, Natick, Mass) in a subintimal plane into the popliteal. After confirming re-entry into the popliteal, the superficial femoral artery was dilated throughout its length with a 5 mm by 10 cm balloon (Fig 3).

Postprocedure ankle/brachial index (ABI) rose from .3 to .9 and remained so 3 months after the procedure. She underwent a total of 8 weeks of antibiotics and had a slow recovery with a prolonged rehabilitation. The patient's progressive ischemia was reversed, and she continued to have slow improvement in her open foot wounds at 3 months.

CASE 2.

A 73-year-old heavy tobacco abuser with metastatic small cell cancer of the lung was transferred from an outside hospital for bilateral lower extremity acute critical ischemia of approximately 6-hour duration. Physical examination showed all lower extremity pulses to be absent with no pedal Doppler signals. Computed tomography scan from the outside institution (Fig 4) was consistent with aortic occlusion.

The patient underwent emergent axillobifemoral bypass with polytetrafluoroethylene. After this initial surgery the patient's critical ischemia was resolved; her ABIs were .75 on the left and waveforms only on the right. Her

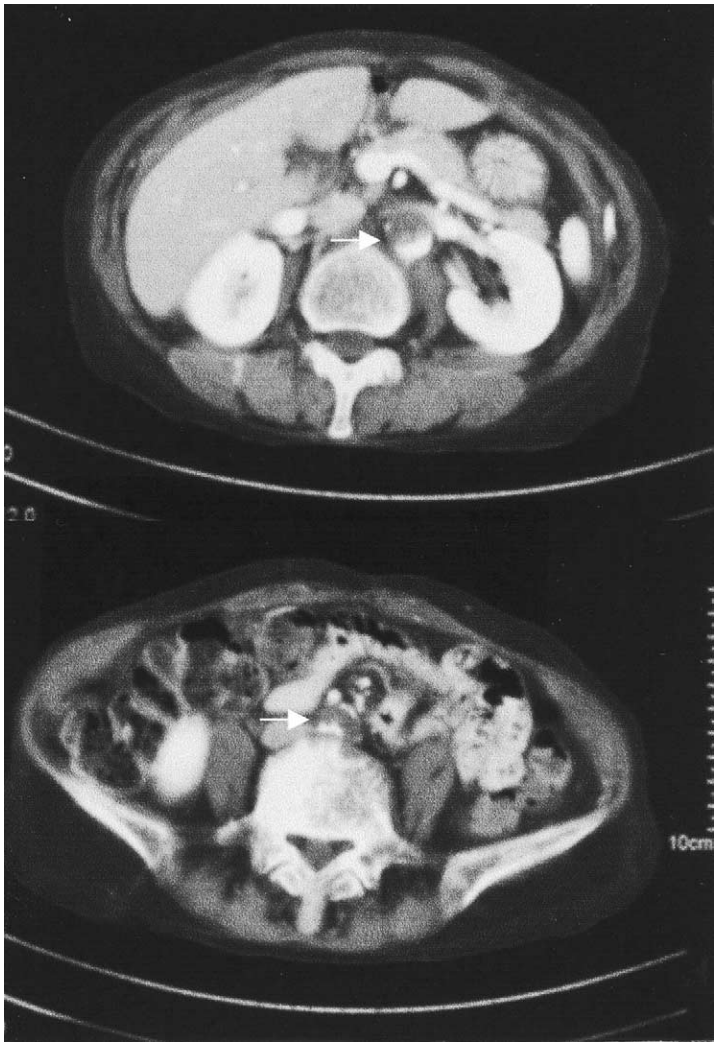

Fig 4. Computed tomography scan demonstrating aortic occlusion in case 2.

postoperative course allowed discharge home by 5 days after surgery.

Twenty-six days after her initial surgery, the patient presented with systemic signs of sepsis and grossly purulent drainage from both groin wounds. Cultures of these wounds were positive for *Staphylococcus aureus*. After antibiotic treatment with intravenous vancomycin, the patient was prepared for graft excision and endovascular recanalization of native circulation for the following day.

Initial management consisted of left brachial access (Fig 5 shows the initial angiogram). Two stiff guidewires were passed through the same 8F brachial sheath into each common femoral artery, and subsequent balloon angioplasty was performed. This was followed by placement of self-expanding stents throughout the length of each aortoiliac occlusion (Fig 6). In each iliac system two 8 × 60 mm Protégé stents (EV3, Plymouth, Minn) were used. The arteriotomy in the brachial artery was then surgically repaired. Subsequently, the infected axillofemoral bypass was excised, and the arteriotomies were repaired with saphenous vein patching. After completion of this procedure the patient had an ABI of .9 on the left and .6 on the right.

The patient was continued on vancomycin for an 8-week course. She continued to have patent iliacs bilaterally with palpable common femoral pulses 4 months after surgery.

DISCUSSION

Prosthetic vascular grafts have allowed revascularization in situations when autogenous conduit was unavailable or unusable. Although uncommon, the single most serious complication associated with prosthetic vascular grafts is infection. Infection always requires some surgical procedure in management, and procedures to revascularize the limb after graft excision must be individualized.

Mortality and limb loss with graft infection are related to both graft location and infecting pathogen. Central

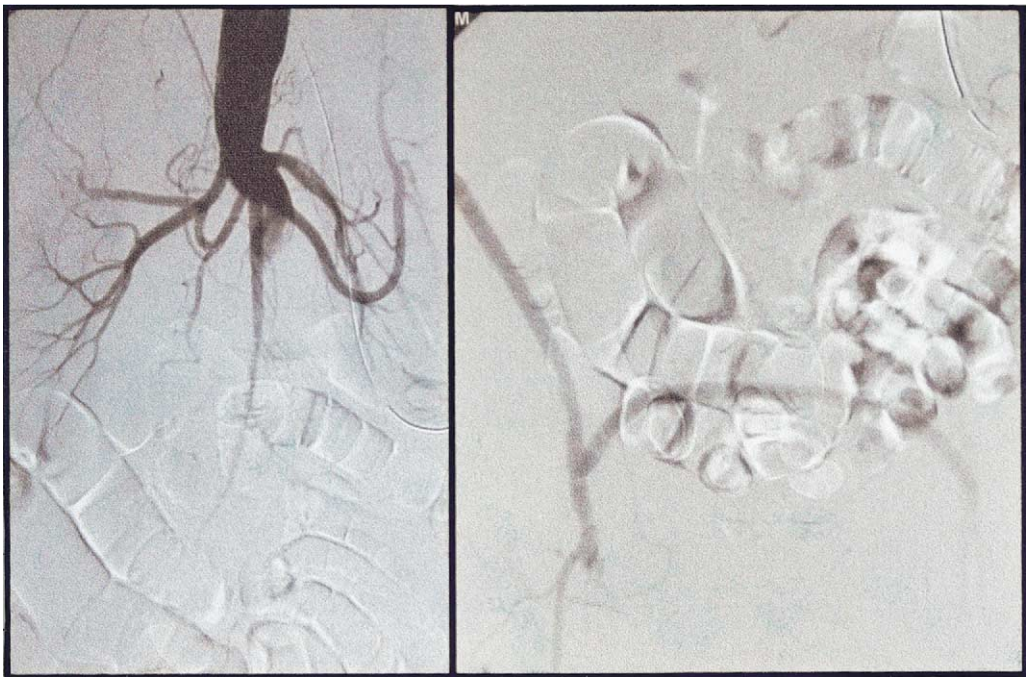

Fig 5. Initial angiogram showing aortic occlusion in case 2.

Fig 6. Complete angiogram of patient in case 2 after endovascular reconstruction of the occluded aorta.

grafts have higher mortality rates, whereas peripheral grafts have higher amputation rates. Organism virulence also influences outcome and management. Those organisms, such as *S epidermidis,* which live within a bacterial biofilm, tend to be less aggressive,[5] and hence less radical management might be acceptable as opposed to gram-negative bacteria or *S aureus*, which tend to be more invasive.

Because of the numerous variations in presentation of graft infection, several techniques have been developed to manage this complication. These vary from conservative partial graft excision and replacement[5,6] to the use of novel conduits or extra-anatomic bypass for revascularization.[7,8]

None of these approaches are ideal in every circumstance. Although selected partial graft preservation and in situ prosthetic graft replacement have been successful in select circumstances,[4,5] these approaches are not acceptable with virulent organisms or when the anastomosis has gross purulence. In a review of infrainguinal vascular graft infections at our institution from 1959 to 1993, partial removal of graft resulted in an 82% rate of continuing sepsis, which was significantly higher than the rate for those patients who were treated with total graft excision.[8] In situ revascularization with autogenous conduit is acceptable, but it too can be associated with recurrent infection or graft disruption,[9,10] and often the patient who receives a prosthetic graft does so because of limited autogenous conduit initially. Alternative conduits such as cadaveric vein have been proposed[7,11] but have not gained widespread acceptance.

Alternative approaches to the cases we presented were possible. In case 1, an extra-anatomic bypass could have been constructed to revascularize the patient's limb; however, given her poor medical condition at the time, it was considered preferable to minimize her operative time. An-

other option, although somewhat unsavory, could have been primary amputation along with excision of the graft. In case 2, bilateral axilloprofundus bypasses through clean planes could have been an acceptable alternative. Such bypasses have been associated with poor long-term patency,[9] although that probably would not have been a major issue in a patient with metastatic small cell lung cancer. The main risk of such an approach would have been continued sepsis as a result of infection of the new prosthesis.

Under more elective conditions, these cases would not be considered by most to be ideal candidates for endovascular therapy. This relates primarily to the lower patency when angioplasty ± stenting are used with extensive aortoiliac occlusive disease or long superficial femoral artery occlusions.[12-15] Nevertheless, when managing an infected prosthetic graft, patency is not the primary concern. Instead, priority should be given to controlling the infection while minimizing risk of amputation and mortality. Part of the benefit of the endovascular approach is to minimize the extent of surgery, thereby potentially reducing the risk of mortality. Even if future failure of the endovascular approach occurs, it might be preferable to do a surgical bypass at that time, when ideally the infection might have been completely resolved. With an approach such as this, one might be able to avoid or minimize extra-anatomic bypasses. In addition, even in cases in which autologous conduit is available, it might be preferable to perform an endovascular recanalization at the time of excision of the infected graft, so that if, in the future, the endovascular approach fails, a vein bypass could be constructed under more favorable elective conditions. The endovascular recanalization can be performed at the time of graft excision as in case 2 or after recurrent ischemia is confirmed postoperatively as in case 1. The approach for endovascular recanalization will often be from the contralateral femoral but might be brachial. Whatever approach is chosen, strict aseptic technique should be followed to prevent contamination of the access site.

It should be stressed that the endovascular approach is often not possible. This might be related to the extent of the occlusive disease, inability to traverse an occlusion, and/or re-enter arterial lumen distally. In addition, this should not be considered a first line approach to prosthetic graft infections, given the limited experience with the approach and lack of long-term follow-up. The benefits of the other more proven approaches should always be carefully weighed against the potentially less invasive benefits of endovascular recanalization. Endovascular recanalization of native vessels in the management of infected arterial prosthetic grafts can be a useful tool and should be considered in the treatment of these challenging patients.

REFERENCES

1. Edwards WJ, Kaiser AB, Tapper S, Edwards WH, Martin RS, Mulherin JL, et al. Cefamandole versus cefazolin in vascular surgical wound infection prophylaxis: cost-effectiveness and risk factors. J Vasc Surg 1993;18:470-6.
2. Edwards WH, Martin RS, Jenkins JM, Edwards WH, Mulherin JL. Primary graft infections. J Vasc Surg 1987;6:235-9.
3. Liekweg WG Jr, Greenfield LJ. Vascular prosthetic infections: collected experience and results of treatment. Surgery 1977;81:335-42.
4. Calligaro KD, Veith FJ, Gupta SK, Ashcer E, Dietzek AM, Franco CD, et al. A modified method for management of prosthetic graft infections involving an anastomosis to the common femoral artery. J Vasc Surg 1990;11:485-92.
5. Bandyk DF, Bergamini TM, Kinney EV, Seabrook GR, Towne JB. In situ replacement of vascular prostheses infected by bacterial biofilms. J Vasc Surg 1991;13:575-83.
6. Miller JH. Partial replacement of an infected arterial graft by a new prosthetic polytetrafluoroethylene segment: a new therapeutic option. J Vasc Surg 1993;17:546-58.
7. Verheist R, Lacroix V, Vraux JP, Vandamme H, Limet R, Nevelsteen A, et al. Use of cryopreserved arterial homografts for management of infected prosthetic grafts: a multicentric study. Ann Vasc Surg 2000;14:602-7.
8. Mertens RA, O'hara PJ, Hertzer NR, Krajewski LP, Beven EG. Surgical management of infrainguinal arterial prosthetic graft infections: a review of a 35-year experience. J Vasc Surg 1995;21:782-91.
9. Hepp W, de Jonghe K, Pallua N. Late results following extra-anatomic bypass procedures for chronic aortoiliac occlusive disease. J Cardiovasc Surg 1988;29:181-5.
10. Samson RH, Veith FJ, Janko GS, Gupta SK, Scher LA. A modified classification and approach to the management of infections involving peripheral arterial prosthetic grafts. J Vasc Surg 1988;8:147-53.
11. Fujitani RM, Bassiouny HS, Gewertz BL, Glagov S, Zarins CK. Cryopreserved saphenous vein allogenic homografts: an alternative conduit in lower extremity arterial reconstruction in infected fields. J Vasc Surg 1992;15:519-26.
12. Powell RJ, Fillinger M, Walsh DB, Zwolak R, Cronenwett JL. Predicting outcome of angioplasty and selective stenting of multisegment iliac artery occlusive disease. J Vasc Surg 2000;32:564-9.
13. Timaran CH, Stevens SL, Freeman MB, Goldman MH. External iliac and common iliac artery angioplasty and stenting in men and women. J Vasc Surg 2001;34:440-6.
14. Capek P, McLean GK, Berkowitz HD. Femoropopliteal angioplasty: factors influencing long-term success. Circulation 1991;83(S1):170-80.
15. Stanley B, Teague B, Raptis S, Taylor DJ, Berce M. Efficacy of balloon angioplasty of the superficial femoral artery and popliteal artery in the relief of leg ischemia. J Vasc Surg 1996;23:679-85.

Submitted Aug 14, 2004; accepted Oct 23, 2004.